

INTERNATIONAL FOOD INFORMATION SERVICE

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FAB 3

NATURAL AND SYNTHETIC SWEETENERS

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under the direction of

Commonwealth Agricultural Bureaux, Farnham Royal, Bucks; Gesellschaft für Information und Dokumentation, Frankfurt am Main; Institute of Food Technologists, Chicago; Centrum voor Landbouwpublikaties en Landbouwdocumentatie (Pudoc), Wageningen.





## INTRODUCTION

Food Annotated Bibliographies (FABs) are collections of abstracts on specific topics in food science and technology. The topics are chosen by the staff of the International Food Information Service as being of particular interest or importance. The topics normally interest individual workers, who may not require the full information provided in Food Science and Technology Abstracts, from which the abstracts for FABs are taken. The size and the cost of the FABs are controlled as much as possible with the interests of individual workers in mind.

Titles of the FABs now available are given on the back cover of this booklet. New titles are being added at the rate of about 10 per year. For up-to-date lists of FABs or suggestions for new topics please write to the address given overleaf. New subjects are searched for at least the five most recent volumes of Food Science and Technology Abstracts. Thereafter each FAB is updated monthly. Copies of each month's abstracts on any topic may be obtained as indicated on the back cover of this publication. At the end of each volume of up-dating, the abstracts are merged and made available as a separate supplement to the original FAB.

Some of the larger FABs have been divided into sections to facilitate use. Abstracts are not printed in more than one section. The larger FABs also have subject indexes provided.

Copies of all original articles referred to in the abstracts may be bought (or occasionally borrowed) from the International Food Information Service. A form for ordering these is provided at the end of this FAB.

Coverage of the subject has been restricted to that of Food Science and Technology Abstracts, which covers over 1200 of the important food journals, patents from 20 countries and books published world-wide. Every effort is made to include all significant references, but editorial discretion is used on the many articles of borderline interest. If the reader particularly needs an exhaustive search of the subject, we will be pleased to provide any other references that we have available. We would, in any case, encourage readers to write or telephone us with any comments or queries that they may have.

H. BROOKES

ASSISTANT EDITOR







## 1

**Nutritional design.**

Anon.

*Food Engineering International* 2 (6) 38-43 (1977) [En, de, fr, es]

6 products are describe which are linked by the general theme of designing improvements in nutritional performance of foods. Nigerian Soy-Ogi is a version of a traditional corn mash fed to infants, fortified with soy proteins. Wet-milled corn and cooked soy beans are mixed as slurries and fermented. The product, sold after pasteurization and spray-drying, contains: protein 20.5%; carbohydrate 58.5%; fat 9.5%; moisture 7.0%; and ash 3.0%. A dried whole milk made by Milkfood AB, Kageröd, Sweden has a shelf life of > 1 yr. A spray-drying process encapsulates the butter fat, protecting it from oxidation, giving a composition of fat 26%, proteins 26%, lactose 37%, minerals 6% and moisture 3%. The fat content can be altered up to 75%. Textured soy proteins, designed for sausage formulations or as analogues of boiled meat, are produced in a pilot plant of Rhone-Poulenc, France. The products contain 21-23% protein, 70-75% moisture and 0.05-7.54% lipids. The uses of xylitol as a replacement for sugar in foods for diabetics, or as a non-cariogenic sweetener are described. Other possible uses include preserves, but xylitol is restricted for general food use in several countries; the regulations in 14 countries are summarized. Vitana yoghurt sold by Toni-Molkerei, Zürich, Switzerland, is fortified by the addition of 9 vitamins, to the level where a single container contains the basic daily requirement for each vitamin. [Continued in following abstr.]

DIH

## 2

[Comparison between keeping qualities of beverages containing fruit juices or sweetened with sucrose and saccharin.] Die Haltbarkeit von Getränken mit Fruchtsaft im Vergleich zu mit Saccharose und Saccharin gesüßten Getränken. Svorkova, L.

*Lebensmittel-Industrie* 24 (4) 169-172 (1977) [De, en, ru] [Res. Inst. for Balneology, Mariánské Lázně, Czechoslovakia]

Mineral water beverages with additions of fruit syrups (blackcurrant, cherry, apple) or sweetened with sugar and, if necessary, saccharin were incubated at 25°C for 68 days for keeping quality comparisons. Numbers of psychrophiles, mesophiles, slime-forming bacteria, yeasts and moulds were determined; there were no significant differences between mineral water-fruit syrup and mineral water-sugar syrup beverages. N-compounds encouraged microbial proliferation; sugar contents <3.5% had little effect on growth. Addition of ascorbic acid, a high CO<sub>2</sub> content and low pH (<3.0) favoured a good keeping quality; beverages with blackcurrant or cherry were more stable than those with apple. IN

## 3

[Method of preparation of sugar substitute.]

Verfahren zur Herstellung von Zuckerersatz.

Chimicasa GmbH

*Swiss Patent* 587 023 (1977) [De]

A sweetener for low-calorie diets is prepared by dissolving the following in water: 1 part of sodium or calcium saccharinate or cyclamate; 20-40 parts of filling matter which consists of the Na or K salt of an edible organic acid such as acetic, citric, tartaric or malic acids, or calcium lactate which may contain a small proportion of albumen and glucose, maltose and/or dextrin; and 0-0.02 parts of soluble vitamins/part of filling. The solution is air- or spray-dried to a granular powder of 0.07-0.1 g/cm<sup>3</sup> apparent density. W&Co

## 4

**Chewing gum of longer lasting sweetness and flavor.**

Bahoshy, B. J.; Klose, R. E.; Nordstrom, H. A. (General Foods Corp.)

*United States Patent* 4 036 992 (1977) [En]

Sugar sweetened chewing gums are given longer lasting sweetness and flavour by the incorporation of L-aspartyl-L-phenylalanine methyl ester. IFT

## 5

**Low calorie sweeteners fast encroaching on sugar market.**

Anon.

*Confectionery Production* 43 (10) 408, 420 (1977) [En]

Due to placement of saccharin under temporary control in Japan, a need for a natural low-calorie sweetener has arisen. This has resulted in increased cultivation of *Stevia rebaudiana* Bartoni, the source of stevioside, a natural sweetener. Problems of cultivation (sensitivity to weather conditions and diseases, and low quality) have been solved by selection, maintenance of the plant during winter, and soil management; this has opened the way to quick and extensive cultivation in the future. The potential for use of isomerized sugar and glycyrrhizin as sweeteners is also discussed. A list is given of sweeteners currently produced in Japan, together with their sources and leading producers. SP

## 6

**Recent aspects of the chemistry of disaccharides.**

[Lecture]

Hough, L.; Richardson, A. C.

*Pure and Applied Chemistry* 49 (8) 1069-1084 (1977) [57 ref. En] [Dep. of Chem., Queen Elizabeth Coll., Kensington, London W8 7AH, UK]

Stereoselective chemical manipulation of readily-available disaccharides by replacement of specific hydroxyl groups (e.g. by halogenation) or by selective esterification of the more reactive hydroxyl groups is discussed. Chemical studies with



sucrose have shown that 1',4,6,6'-tetrachloro-1',4,6,6'-tetra-deoxy-galacto-sucrose is intensely sweet, comparable to saccharin but with a pleasant aftertaste; the causes of the apparent loss of sweetness of galacto-sucrose are discussed. AL

## 7

### Uses and metabolic effects of xylitol. I.

Fratzke, A. R.; Reilly, P. J.

*Process Biochemistry* 12 (7) 27-29 (1977) [32 ref. En] [Dep. of Chem. Eng. & Nuclear Eng., Iowa State Univ., Ames, Iowa 50011, USA]

This article describes the production of xylitol, a sweetener, from xylans by chemical and enzymic means. A table of relative sweetness (taking glucose as 1.00) of sugars and sugar alcohols at equal wt.% concn. (low concn.) and at equimolar concn. (high concn.) is given; results show values of 1.92 for xylitol and 2.05 for fructose at 1% concn., and 1.34 for xylitol and 3.20 for sucrose at a concn. of 1M. SP

## 8

### [Artificial sweetener.]

Taito Co. Ltd.

*Japanese Patent* 5 218 780 (1977) [Ja]

Mixtures of a saccharide liquor containing oligosaccharide, a starch hydrolysis product and flavouring agents are subjected to vacuum foam drying. IFT

## 9

### Inorganic salts of dipeptide sweeteners.

Hass, G. J.; Berg, J. H. (General Foods Corp.)

*United States Patent* 4 031 258 (1977) [En]

Foods are sweetened artificially by incorporation of novel inorganic salts of dipeptide sweeteners which are said to dissolve faster than the corresponding unsubstituted compounds. IFT

## 10

### Licorice, glycyrrhiza and ammoniated glycyrrhizin. Proposed affirmation of GRAS status with special limitations as direct human food ingredients.

United States of America, Food & Drug Administration

*Federal Register* 42 (148, Aug. 2) 39117-39120 (1977) [En] [Washington DC, USA]

A summary of the literature related to the safety of liquorice, glycyrrhiza and ammoniated glycyrrhizin is given. There is no evidence that suggests a hazard to the public when these materials are used at current levels, but it is not possible to determine if a significant increase in consumption would constitute a dietary hazard. The FDA proposes to affirm liquorice, glycyrrhiza, and ammoniated glycyrrhizin as generally recognized as safe (GRAS), with specific limitations on their use. CAS

## 11

### [Production of invert sugar from the starch, and the possibilities of its application.]

Boskov, Z.; Jakovljevic, J.; Nikolov, Z.

*Hrana i Ishrana* 18 (3/4) 188-198 (1977) [41 ref. Sh, en] [Tehnoloski Fak., Novi Sad, Yugoslavia]

Increased demand for and limited supply of sucrose has resulted in the development of new sweeteners, especially so-called 'isomerase'. D-glucose is partially isomerised to D-fructose through the action of the enzyme glucose isomerase from *Streptomyces phaeochromogenes*, *Str. albus*, *Str. olivochromogenes*, *Lactobacillus brevis*, *Bacillus coagulans* and *Aerobacter* sp. The enzyme is activated by Co and Mg ions and inactivated by Ca and O<sub>2</sub>. The product obtained resembles inert sugar from sucrose; contains 29% water and 71% DM (50% D-glucose, 42% D-fructose, 8% other sugars, 0.03% ash and 0.002% N). It is concluded that it could be used in most of the traditional areas of use of sucrose. IN

## 12

### Should the Delaney clause be changed? A debate on food additive safety, animal tests, and cancer.

Anon.

*Chemical and Engineering News* 55 (26) 24-28, 33-46 (1977) [En]

4 experts present their contrasting views on the US intention to ban saccharin as a food additive. AL

## 13

### Sweetening composition and process therefore.

Shoaf, M. D.; Pischke, L. D. (General Foods Corp.)

*United States Patent* 4 004 039 (1977) [En]

A sweetening composition based on L-aspartyl-L-phenylalanine methyl ester crystals is stabilized and formed into a flowable matrix by mixing it with one of a number of different fusing agents, which include dairy by-products, such as whey. EJM

## 14

### Determination of sodium saccharin in chewing gum by high pressure liquid chromatography.

Eng, M.-Y.; Calayan, C.; Talmage, J. M.

*Journal of Food Science* 42 (4) 1060-1061 (1977)

[3 ref. En] [R&D Dep., American Chicle Div., Warner-Lambert Co., Long Island City, New York 11101, USA]

A method is presented for the precise and accurate detn. of sodium saccharin in chewing gum utilizing high pressure liquid chromatography. The sodium saccharin is extracted into a biphasic solvent system and quantitated by the internal standard method. The procedure presented exhibits a recovery of 101.3% with an s.d. of 2.6%. Results of the analysis of 5 different flavours of 2 commercial brands of sugarless chewing gum indicate a range of 79-116% of label claim. No evidence of chemical degradation of the sodium saccharin was found. IFT



## 15

**How sweet it is. [Lecture]**

Morrison, A. B.

*Journal of the Canadian Dietetic Association* 38 (4) 282-289 (1977) [5 ref. En]

Results of saccharin toxicity trials with rats are discussed and the action taken by the Canadian Department of Health and Welfare to limit the use of saccharin as a sweetener in foods and beverages because of the carcinogenic risk is justified. General conclusions from risk-benefit studies are summarized. AL

## 16

**Xylitol - a sugar that counters dental decay.**

Makinen, K. K.

*Confectionery Production* 43 (11) 464-466 (1977)

[3 ref. En] [Inst. of Dentistry, Univ. of Turku, Turku, Finland]

125 subjects, divided into 3 groups, were used in a 2 yr clinical trial on dental caries, each test group being given only sucrose, fructose, or xylitol. At the end of 2 yr, xylitol was found to have reduced dental caries by 90% referred to the frequency with sucrose; fructose showed a reduction of approx. 35%. The xylitol diet reduced plaque by approx. 50%, had no periodontally harmful effects, reduced incidence of cariogenic and acidogenic bacteria and did not produce any abnormality of blood or urine samples. Trials over a 1 yr period using chewing gum sweetened with sucrose or xylitol showed that xylitol chewing gum had a clear non-cariogenic effect and reduced dental caries at a highly significant level. SP

## 17

**[Stevioside sweetener.]**

Nisshin Sugar Manufacturing Co. Ltd.

*Japanese Patent* 5 227 225 (1977) [Ja]

Stevioside sweetening compositions containing maltitol and fructose are used for improving taste properties. IFT

## 18

**[Process for the two-stage solubilization of the hemicelluloses of natural products containing xylan in the production of xylose.]** Verfahren zum zweistufigen Aufschliessen der Hemicellulosen von xylanhaltigen Naturprodukten zwecks Gewinnung von Xylose.

Buckl, H.; Fahn, R. (Süd-Chemie AG)

*German Federal Republic Patent Application* 2 553 647 (1977) [De]

Xylose for use in the food industry, and xylitol for use as a sweetener for diabetics, are obtained by treating products which contain xylan (such as oat husks, straw, corn cob and bagasse) in a 1st stage with an alkali hydroxide solution and extracting the residue, and in a 2nd stage by treating the extraction residue from the 1st stage with diluted acid and extracting the residue. The diluted acid solution obtained in the 2nd stage is used for

obtaining the xylose and xylitol. The alkali hydroxide solution from the 1st stage can be treated to obtain organic acids and lignin. Treatment in the 1st stage is at normal or slightly increased pressure using a 0.05-0.50M alkali hydroxide solution. The 2nd stage treatment is effected at increased pressure at 120-140°C for 15-45 min with an amount of acid just sufficient to be taken up by the solid extraction residue of the 1st stage. Preferably the dil. acid used in the 2nd stage is 0.5-5.0 wt.% H<sub>2</sub>SO<sub>4</sub>. W&Co

## 19

**[Determination of benzoic acid-saccharin mixtures by differential spectrophotometry.]**

Calapaj, R.; Ciraolo, L.; Micali, G.

*Rassegna Chimica* 29 (1) 26-31 (1977) [7 ref. It, en] [Istituto di Merceologia, Univ. di Messina, Messina, Italy]

This paper describes a method for detn. of mixtures of saccharin and benzoic acid in orange-based soft drinks by differential spectrophotometry. Good recoveries were achieved over a wide range of saccharin/benzoic acid ratios, e.g. for saccharin:benzoic acid mixtures of 10 + 200 p.p.m., recoveries were 92 and 105%; for 100 + 20 p.p.m., recoveries were 93 and 100%, resp. RM

## 20

**[Xylitol: dietetic properties and techniques of application.]**

Kracher, F.

*Revue des Fabricants de Confiserie, Chocolaterie, Confiturerie, Biscuiterie* 52 (9) 14-24 (1977) [Fr] [Soc. Givaudan, Dübendorf, Switzerland]

This review describes the chemical structure of xylitol, its occurrence in some natural products, industrial production, and its physical, chemical, organoleptic, physiological and technological properties when used as a sugar substitute in confectionery products (chocolate, chewing gum, fatty centres, dragees, toffees, jellies, fondants, boiled sweets). RM

## 21

**[Lycasin: dietetic properties and techniques of application of a new type of lycasin.]**

Rockstrom, E.

*Revue des Fabricants de Confiserie, Chocolaterie, Confiturerie, Biscuiterie* 52 (9) 26-31 (1977) [Fr] [Lyckeby, Bastad, Sweden]

Lycasin 80/55, a new type of lycasin designed to reduce dental caries, is described. It is a hydrogenated glucose syrup containing sorbitol and hydrogenated di-, tri- and polysaccharides. Details are given of its composition, specification, identification, physical properties, relevant legislation and applications for non-cariogenic confectionery products (boiled sweets, jellies, chewing gums). RM



## 22

**Levulose containing sweetening compositions.**

Walon, R. G. P. (CPC International Inc.)

*United States Patent* 4 049 466 (1977) [En]

A solid sweetening composition comprises 10-50 wt. % fructose and 50-70 wt. % starch hydrolysate.

IFT

## 23

**[Sweetening agent.] Süsstoff.**

Wagner, H.; Maierhofer, A. (Deutsche Gold- und Silber-Scheideanstalt vormals Roessler)

*German Federal Republic Patent Application* 2 614 585 (1977) [De]

Sweetener for use in warm meals, bakery products, beverages etc. consists of the potassium salt of D,L-2-hydroxy-4-methylvaleric acid. The acid can be obtained by conversion of isovaleraldehyde with hydrogen cyanide and subsequent hydrolysis of the cyanohydrin. The K salt can then be produced by adjusting the pH of an aqueous solution of the acid to 7 by adding potassium hydroxide and evaporating or spray-drying the mixture. The sweetening capacity of the resultant thermally stable K salt is similar to that of sodium cyclamate. W&Co

## 24

**Artificial sweetener.**

Hoechst AG

*British Patent* 1 483 875 (1977) [En]

A process for the manufacture of 6-methyl-3,4-dihydro-1,2,3-oxathiazin-4-one 2,2-dioxide is described. IFT

## 25

**Artificial sweeteners and human bladder cancer.**

Howe, G. R.; Burch, J. D.; Miller, A. B.; Morrison, B.; Gordon, P.; Weldon, L.; Chambers, L. W.; Fodor, G.; Winsor, G. M.

*Lancet* 2 (8038) 578-581 (1977) [15 ref. En] [Epidemiology Unit., Nat. Cancer Inst. of Canada, Univ. of Toronto, Toronto, Ontario, Canada]

The effect of artificial sweeteners on bladder cancer was studied in male and female cases and controls. Risk ratio was  $> 1$  for male controls and in general  $< 1$  for female controls. Variables such as grades of school, occupational exposure, history of bladder infections, history of kidney infections, smoking, instant coffee consumption and use of non-public water supply were controlled. It is concluded that there is a positive association between use of artificial sweeteners (saccharin) and risk of bladder cancer in males. Artificial sweeteners were not found to be causes of bladder cancer in females. SP

## 26

**Bladder cancer and saccharin.**

Anon.

*Lancet* 2 (8038) 592-593 (1977) [19 ref. En]

A study on the relationship between artificial-sweetener use and risk of bladder cancer by Howe

et al. [see preceding abstr.] is criticized and weaknesses in the study outlined. SP

## 27

**Artificial sweeteners and bladder cancer.**

Miller, A. B.; Howe, G. R.

*Lancet* 2 (8050) 1221-1222 (1977) [7 ref. En]

[Epidemiology Unit, Nat. Cancer Inst. of Canada, Univ. of Toronto, Toronto, Ontario, Canada]

Criticisms in the editorial [see preceding abstr.] of the authors' paper are discussed and include: sampling methods; controlling factors such as smoking, drinking instant coffee, schooling, occupation, history of bladder and kidney infections, water supply and artificial sweetener use; differences between males and females; and diabetics. SP

## 28

**Dulcosides A and B, new diterpene glycosides from *Stevia rebaudiana*.**

Kobayashi, M.; Horikawa, S.; Degrandi, I. H.; Ueno, J.; Mitsuhashi, H.

*Phytochemistry* 16 (9) 1405-1408 (1977) [7 ref. En] [Fac. of Pharmaceutical Sci., Hokkaido Univ., Sapporo 060, Japan]

New diterpene glycosides, dulcosides A and B were isolated from *Stevia rebaudiana* Bertoni and their structures were established as 19-O- $\beta$ -glucopyranosyl-13-O-[ $\alpha$ -rhamnopyranosyl (1-2)]- $\beta$ -glucopyranosyl-steviol and 19-O- $\beta$ -glucopyranosyl-13-O-[ $\alpha$ -rhamnopyranosyl (1-2)- $\beta$ -glucopyranosyl (1-3)]- $\beta$ -glucopyranosylsteviol resp. They showed moderate sweetness, approx. 30 times more than that of sucrose. AS

## 29

**Saccharin and its salts. Final guidelines.**

United States of America, Food & Drug Administration

*Federal Register* 42 (237, Dec. 9) 62209-62211 (1977) [En] [Washington, DC, USA]

Under the Saccharin Study and Labelling Act of 23 Nov. 1977, all consumer packages of food containing saccharin must bear a conspicuous and legible label reading, "Use of this product may be hazardous to your health. This product contains saccharin which has been determined to cause cancer in laboratory animals." CAS

## 30

**The naturally occurring cinnamaldehydes.**

[Review]

Clifford, M. N.; Hole, M.

*Process Biochemistry* 12 (10) 5-9 (1977) [113 ref. En] [Dep. of Sci. & Food Tech., Grimsby Coll. of Tech., Grimsby, UK]

This review considers the natural occurrence, biosynthesis, applications and methods of synthesis of cinnamaldehydes. Data concerning their natural occurrence in non-lignified tissues and reported methods of synthesis are tabulated and a schematic diagram is given of the biosynthesis of cinnamaldehydes associated with lignins.



Cinnamaldehydes have been patented for use as flavouring agents, sweeteners, colorants and odour-modifying agents, e.g. 4-methoxycinnamaldehyde patented as a flavouring agent and sweetener for various foods and soft drinks. Consideration is also given to the natural occurrence of cinnamaldehydes in foods and beverages, e.g. in beverages matured in wooden casks, in smoked foods, in maple syrup, and in green and roasted coffee beans and some instant coffee powders. JA

### 31

Diet soft drinks promise continued growth and profit potential.

Christon, A. S.

*Food Product Development* 11 (1) 56, 59 (1977)  
[En] [Robinson-Humphrey Co., Inc., Atlanta, Georgia, USA]

Consideration is given to factors affecting the future of non-nutritive sweeteners. A demographic profile of soft drink consumption in the USA is presented. This favours an above average future growth in diet drinks. Sweetener consumption is discussed and tabulated data presented to show USA per capita consumption of caloric and non-caloric (saccharin and cyclamate) sweeteners from 1960 to 1976. Consideration is also given to the home and on-premise markets for soft drinks in the USA. VJG

### 32

[Determination of benzoic acid, parabenes and saccharin in non-alcoholic beverages and pharmaceutical products by high pressure liquid chromatography.]

Ciraolo, L.; Calapaj, R.; Clasadonte, M. T.  
*Rassegna Chimica* 29 (4) 181-186 (1977) [21 ref. It, en] [Univ. di Messina, Messina, Italy]

A high pressure liquid chromatography (HPLC) method is described for determining the composition of parabenes (p-hydroxy benzoic acid esters), benzoic acid and saccharin mixtures in citrus-based soft drinks and pharmaceuticals. After extraction, analysis is by HPLC with a reverse phase system, using a phosphate-methanol buffer (pH 3) or water-methanol as mobile phase (depending on the composition of the mixture). Results, shown graphically and in tables, revealed 96-105% recoveries for parabenes, 98-102% for benzoic acid and 93-95% for saccharins in fruit drinks. RM

### 33

High pressure liquid chromatographic determination of saccharin in alcoholic products.

Tenenbaum, M.; Martin, G. E.

*Journal of the Association of Official Analytical Chemists* 60 (6) 1321-1323 (1977) [7 ref. En]  
[Dep. of the Treasury, Bureau of Alcohol, Tobacco & Firearms, Washington, DC 20226, USA]

After preliminary cleanup, sodium saccharin can be quantitatively determined in wines and proprietary drugs by using high pressure liquid

chromatography. The preliminary cleanup removes materials that cause column deterioration, loss of baseline stability, and interfering peaks. The average experimental error found in analyses of 6 sweetened wines for sodium saccharin content was 2.3% and the s.d. was 0.01. Saccharin contents of the wines were 0.47-0.50 g/l. The recovery for the extraction process ranged from 97.8 to 101.6%.

AS

### 34

[Fondant for diabetics.] Diabetikerfondant.  
Thieme, E.

*International Review for Sugar and Confectionery* 30 (12) 444-447 (1977) [De]

After a brief discussion of the basic principles of fondant manufacture, preliminary studies on production of xylitol-based fondants for diabetics are described. 4 recipes were studied, containing 37-74% xylitol, the remainder of the TS comprising sorbitol or fructose. The results show one of these recipes to give a semi-liquid fondant, one to give a soft fondant suitable for filling of moulded chocolate casings, and 2 to give fondants suitable for moulding (in starch or in plastics moulds) and subsequent coating with chocolate. These fondants were of good quality; the 2 mouldable fondants were initially rather hard in texture, but softened after a few days. Practical recommendations are given for manufacture and moulding of xylitol-based fondants. AJDW

### 35

Polymeric food additives - functionality with safety.  
Moore, K. K.

*Food Product Development* 11 (4) 63, 80 (1977)  
[En]

Consideration is given to the development by Dynapol of Palo Alto, California, of polymeric additives which unlike their nonpolymeric counterparts neither enter the bloodstream nor are metabolized. 3 types of additives being developed are: polymeric food colorants (a 5-colour system which, by blending will match selected target shades); antioxidants (instead of BHT, BHA and TBHQ, a single polymeric additive with the balanced functionality of all 3); and sweeteners (development of sufficient molecular size has been achieved, but a sucrose-like flavour is lacking).

VJG

### 36

Density measurement of sweetener solids.  
Heffelfinger, G. P.

*Food Product Development* 11 (5) 28-29 (1977)  
[2 ref. En] [Syrup Plant Quality Control Dep., Coca-Cola USA, Atlanta, Georgia, USA]

Investigations into analytical procedures for density measurement as methods of measuring sugar concn. are briefly reported. Characteristics of the methods considered are: sensitivity, precision, accuracy, reliability, stability, and costs. Interlaboratory tests of Brix measurement are



reported. The most accurate results are obtained by deaerating the sample in a sonic bath and drawing it through a 3-way solenoid valve into the instrument. An air syrup train is created by alternately opening and closing the valve for 1 min. The train purges the cell and sample line. The valve then remains open 1 min to introduce the sample. VJG

### 37

[Sweetening composition.] Süsstoffkomposition. Huber, U.; Vaterlaus, B.; Kossiakoff, N. (L. Givaudan & Cie SA)

*Swiss Patent* 592 418 (1977) [De]

The sweetening composition contains neohesperidene dihydrochalcone, naringin dihydrochalcone or hesperetin dihydrochalcone glucoside and gluconic acid or one of its physiologically compatible salts. The sweetener can be used to sweeten all foodstuffs that hitherto have been sweetened by saccharin, cyclamate etc. It can also be added to other sweeteners such as glucose, fructose, xylose. W&Co

### 38

Saccharin and other sweeteners: mutagenic properties.

Batzinger, R. P.; Ou, S.-Y. L.; Bueding, E. *Science, USA* 198 (4320) 944-946 (1977) [11 ref. En] [Dep. of Path. & Pharmacology, John Hopkins Med. Inst., Baltimore, Maryland 21205, USA]

Saccharin preparations commonly distributed as artificial sweeteners exhibited mutagenic activity in bacterial tests. When administered orally to mice, mutagenic activity was demonstrable in the urines of these animals as well as in a host-mediated assay. Highly purified saccharin was not mutagenic in the direct assay, but the urines of mice to which this material had been administered exhibited mutagenic effects on 1 tester strain (*Salmonella typhimurium* TA100). 2 other sweeteners, neohesperidin dihydrochalcone and xylitol, had no detectable mutagenic activity in any of these assays using his-*Salmonella typhimurium* strains TA100 or TA98. AS

### 39

[Enzyme systems having rhamnosidase activity.]

Enzymsysteme mit Rhamnosidaseaktivität.

Krasnobajew, V. (L. Givaudan & Cie SA)

*Swiss Patent* 589 667 (1977) [De]

The tasteless glyceride hesperidin which occurs in citrus fruit peel may be converted by alkaline treatment, hydrogenating and enzymatic hydrolysis into the highly sweet hesperetin-dihydrochalcone-glucoside, which may be used as a sweetener. The enzyme used for hydrolysis, e.g. naringinase, had to be heated to destroy its  $\beta$ -glucosidase activity, resulting in a partial loss of the rhamnosidase activity. It has now been found that the  $\beta$ -glucosidase activity of a glycolytic enzyme or

enzyme system having rhamnosidase activity, e.g. naringinase and hesperidinase, is inhibited selectively by immobilizing the enzyme on a solid, activated, substrate, preferably porous glass activated with a layer of diazotized amine, preferably 4,4-diamino-diphenylmethane. W&Co

### 40

Sugar substitute.

Süddeutsche Zucker AG

*British Patent* 1 483 998 (1977) [En]

A sugar substitute with a sweetening power estimated to be 45% that of sucrose is prepared by the hydrogenation of a neutral isomaltulose solution to yield glucopyranosido-1,6-mannitol. IFT

### 41

Saccharin: The risks and benefits.

Cohen, B. L.

*Nature, UK* 271 (5645) 492 (1978) [En]

The decision on whether to ban saccharin should, it is argued, be taken in the light of risk-benefit analysis. A possible link between bladder cancer and the use of saccharin [see FSTA (1978) 10 4T117], from which it is estimated that a single average diet drink could reduce life expectancy by only about 9 s, is compared with other hazards, e.g. obesity, smoking, road accidents, etc. The risks of cancer appear to be greatly outweighed by the risks of obesity. AL

### 42

Alternatives to sugar.

Parker, K. J.

*Nature, UK* 271 (5645) 493-495 (1978) [En]

[Tate & Lyle Ltd., Philip Lyle Memorial Res. Lab., Univ., Whiteknights, PO Box 68, Reading RG6 2BX, UK]

The history of the search for an ideal non-nutritive sweetener is outlined. Substances discussed include saccharin (discovered 1879); dulcin; cyclamate (discovered 1937); new synthetic sweeteners, e.g. Aspartame (methyl ester of the dipeptide  $\alpha$ -L-aspartyl-L-phenylalanine),  $\beta$ -neohesperidin dihydrochalcone, oxathiazinone dioxides (e.g. the  $\beta$ -methyl derivative, Acetosulpham, with sweetness intensity approx. one third that of saccharin), 6-chlorotryptophan (approx. 1000 times as sweet as sucrose), a closely related oxime to  $\alpha$ -syn-oxime of perillartine, arylamines (which are generally toxic), and 1',4,6'-trichlorotrideoxygalactosucrose (approx. 600 times sweeter than sucrose); and recently discovered natural sweeteners, e.g. the proteins nonellin from serendipity berries (*Dioscoreophyllum cumminsii*) and thaumatin from fruit of *Thaumatococcus daniellii* (which are 2000 and 4000 times as sweet as sucrose), miraculin which is extracted from berries of *Synsepalum dulcificum*, and naturally occurring sugars and sugar alcohols (e.g. fructose, xylitol and malitol). These sweeteners have not yet all been evaluated for toxicity. AL



## 43

**Specification for dextrose monohydrate.**

India, Indian Standards Institution

*Indian Standard IS:874-1975*, 15pp. (1975) [En]

Price Rs7.00 [Manak Bhavan, 9 Bahadur Shah

Zafar Marg, New Delhi 110002, India]

The standard prescribes requirements and methods of sampling and test for dextrose monohydrate suitable for use in the food preserving industry. Important modifications in this revision of the original 1956 standard are a change in the limit for As to  $\leq 1.1$  p.p.m., substitution of separate requirements for Pb ( $\leq 0.5$  p.p.m.) and Cu ( $\leq 2$  p.p.m.) in place of heavy metals, and deletion of the requirements for chloride, sulphates, less-soluble sugars, solubility and dextrin. AL

## 44

**[Determination of sorbic acid, benzoic acid and saccharin in foods by high speed liquid chromatography.]**

Ueta, M.; Mazaki, M.

*Journal of the Food Hygienic Society of Japan*

*[Shokuhin Eiseigaku Zasshi]* 18 (3) 278-282

(1977) [8 ref. Ja, en] [Kochi Prefectural Public Health Lab., Marunouchi, 2-chome, Kochi-shi, Japan]

An anion-exchange high speed liquid chromatographic method was presented for the simultaneous separation and estimation of sorbic acid, benzoic acid and saccharin in several foods. Filtrates from orange juice and fermented milk were injected into the chromatograph. Solid foods such as cooked beans and cooked fish cake (kamaboko) were extracted with borate buffer solution (pH 9.2) and filtered through a 0.45  $\mu$ m pore membrane filter. Samples were eluted from a Permaphase AAX column and were determined with a UV detector. TM

## 45

**[Sugar substitutes. Possibilities and problems of the use of sorbitol, mannitol, xylitol and fructose in special confectionery products.]**

Zuckeraustauschstoffe. Möglichkeiten und Probleme der Anwendung von Sorbit, Mannit, Xylit und Fruktose in speziellen Zuckerwaren. Völker, H. H.

*Süßwaren* 21 (19) 586-590 (1977) [De]

The technological characteristics, physiological effects and legal status of the following sweeteners are discussed: sorbitol, fructose, mannitol, xylitol, maltitol, sorbose, glucose syrup and lactitol. Applications of these sweeteners in dietetic foods are considered, in relation to their water retention capacity, low intestinal absorption, low calorific value, reduced cariogenic activity, insulin-sparing activity, protective effects on the liver, laxative action and vitamin stabilizing activity; technological aspects of boiled sweet production using these sweeteners are discussed. IN

## 46

**Xylitol chewing gum with hydrophilic colloid barrier.**

Reggio, R. A.; Friello, O. R.; Beam, J. E. (Life Savers Inc.)

*United States Patent* 4 065 578 (1977) [En]

Xylitol sweetened chewing gum compositions contain xanthan gum or an alginate derivative of kelp as a binder to facilitate formation of a soft, moist, continuous cohesive gum. IFT

## 47

**Alternatives to sucrose.**

Warner, S.

*Food Trade Review* 47 (8) 449-451 (1977) [10 ref. En] [Nat. Coll. of Food Tech., Univ. of Reading, Weybridge, Surrey, UK]

Consideration is given to the following sucrose alternatives: saccharin; cyclamates; glucose syrups; fructose; amino acids; aspartame; chlorotryptophan; dihydrochalcones; SRI Oxime V; and sweet principles from plants (stevioside, glycyrrhizin, miraculin, monellin, and thaumatin). VJG

## 48

**Xylitol, its properties and food applications.**

Emodi, A.

*Food Technology* 32 (1) 28-29, 31-32 (1978) [25 ref. En] [Development Dep., Hoffmann-La Roche, Inc., Nutley, New Jersey 07110, USA]

Xylitol, a naturally occurring sugar alcohol, is readily soluble in water and has a sweetening power similar to that of sucrose, 2.5x that of mannitol and 2.5x that of sorbitol. It does not undergo Maillard browning or caramelization, is not utilized by most microorganisms and has a tolerance level of 20-30 g as a single dose for humans. Xylitol can be used as a sweetener in place of sucrose in chewing gums, chocolate, toffees and caramels, gelatin, desserts, jams, boiled sweets, bakery goods, ice cream, ketchup, condensed milk and sauces. MEG

## 49

**Sensory evaluation of a new dihydrochalcone sweetener. I. Studies in aqueous solutions.**

Lindner, K.; Czetenyi, C.; Kubat, K.; Bolla, E.; Szejtli, J.

*Acta Alimentaria* 6 (4) 311-322 (1977) [8 ref. En] [Coll. of Commerce & Catering, H-1054 Budapest, Alkotmany u. 9-11, Hungary]

The sweetening capacity of a new artificial sweetener CH-401 [empirical formula,  $C_{19}H_{21}O_5SNa$ ] decreased significantly with increasing concn. Compared at sweetness levels corresponding to 9, 18 and 90 p.p.m. solutions of CH-401, the new compound was found to be sweeter than sucrose by factors of 1467, 1022 and 278 resp. Compared with saccharin Na, the sweetening value of which was considered to be



440-fold, the sweetening value of CH-401 was between 650 and 700 at a sweetening level equivalent to 2% sucrose. AS

## 50

**Sensory evaluation of a new dihydrochalcone sweetener. II. Studies in foods.**

Lindner, K.; Czetenyi, C.; Kubat, K.; Bolla, E.; Szejtli, J.

*Acta Alimentaria* 6 (4) 323-330 (1977) [3 ref. En] [Coll. of Commerce & Catering, H-1054 Budapest, Alkotmany u. 9-11, Hungary]

A new artificial sweetener CH-401 gave a good overall effect when used in solutions having salty or sour flavour. In the presence of bitter taste components as well as in confectionery products containing substantial amounts of egg yolk and milk fat, the sweetening capacity diminished and a metallic by-taste was experienced. With tea and lemonade a sweetening effect almost comparable to sucrose could be attained if the sweetener was combined to a level of one third of the total sweetening effect, with sucrose. In the case of certain foods (tomato sauce, compotes), a flavour-equalizing, aroma-enhancing effect could be noted in the presence of CH-401, in addition to a satisfactory sweetening effect. [See preceding abstr. for part I.] AS

## 51

**Antibodies to thaumatin as a model of the sweet taste receptor.**

Hough, C. A. M.; Edwardson, J. A.

*Nature, UK* 271 (5643) 381-383 (1978) [13 ref. En] [Tate & Lyle Ltd., Group Res. & Development, Philip Lyle Memorial Res. Lab., PO Box 68, Reading, UK]

Thaumatococcus, a protein derived from the fruit aril of the West African plant *Thaumatococcus danielli*, is about 200 000 times sweeter than sucrose on a molar basis. While developing a radioimmunoassay for thaumatin it was discovered that thaumatin antibodies will cross-react with a wide variety of other sweetening agents. Although these sweeteners have widely differing molecular structures their immunoreactivity and differential sweetness ranked in an almost identical order, with a high correlation coeff. Binding of sweet substances to antibodies against thaumatin may provide a useful model for the study of interactions at the taste receptor for sweetness and perhaps an in vitro procedure for the recognition of novel sweet substances. AL

## 52

**Artificial sweeteners.**

Nash, L. H.

*Food Legislation Surveys, Leatherhead Food RA* No. 1, 18pp. (1977) [En] Price Members £2.00, Non-members £4.00 [Leatherhead Food RA, Randalls Rd., Leatherhead, Surrey, UK]

This survey summarizes the existing legislation worldwide on artificial sweeteners. Tabulated data summarize the use of cyclamates and saccharin in certain commodities in the major countries of the world. Available information on the use of sorbitol, mannitol, glycerol and xylitol as sweeteners in certain commodities is tabulated for the individual EEC countries and for 16 other countries. 2 additional tables present a guide to labelling requirements on foodstuffs containing artificial sweeteners and present information on the use of cyclamates and saccharin in other countries. VJG

## 53

**[Sweetener.] Süsstoffmischung.**

Rymon Lipinski, G.-W. von; Lück, E. (Hoechst AG)

*German Federal Republic Patent Application* 2 628 294 (1977) [De]

A sweetener having an improved, sucrose-like taste consists of aceto sulphamates and > 1 sweetener belonging to the group of aspartyl peptide esters, sulphamates, sulphimides and dihydrochalcones. The sweetener is added to food and beverages. W&Co

## 54

**Effects of temperature and concentration on the relative sweetness of fructose, glucose and xylitol.** Hyvönen, L.; Kurkela, R.; Koivistoinen, P.; Merimaa, P.

*Lebensmittel-Wissenschaft und -Technologie* 10 (6) 316-320 (1977) [20 ref. En] [Dep. of Food Chem. & Tech., Univ. of Helsinki, SF-00710 Helsinki 71, Finland]

The effect of temp. on the sweetness of sucrose and on the relative sweetness of fructose, glucose and xylitol compared to 5, 10 and 20% sucrose references was determined by an experienced taste panel using a forced-choice paired comparison method. The effect of concn. on the relative sweetness of the sweeteners was also estimated. The sweetness of sucrose was about 10% lower at refrigerator temp. (5°C) and about 10% higher at 50°C as compared to the sweetness at 22°C. Temp. had a noticeable influence on the relative sweetness of fructose. The effect of concn. was not significant. The relative sweetness of glucose differed only slightly with the temp., but the relative sweetness of glucose at the higher concn. was significantly greater than at the lower concn. At 5° and 22°C the sweetness of xylitol at lower concn. was near that of sucrose. At the higher temp. (37° and 50°C) the relative sweetness of xylitol was somewhat less. The relative sweetness of xylitol was also greater at higher concn. than at the 5% level at every temp. studied. AS

## 55

**Sweeteners from starch.**

Keim, C. R.

*Sugar y Azucar* 73 (2) 53-56, 78-79, 81, 84 (1978) [2 ref. En, Es]



The potential of starch-derived sweeteners (especially high-fructose corn syrup) is discussed, with special reference to the situation in the USA. Aspects discussed include: the relative market shares of cane sugar, beet sugar and starch-derived sweeteners; the relative prices of these products; the availability of high-fructose corn syrup only as a liquid, and studies on development of dried products; the potential for synthesis of sucrose from starch-derived glucose and fructose; quality aspects; the relatively high value of by-products of corn syrup, and consequent beneficial effects on profitability; manufacture of alcohol in corn syrup plants; high-fructose syrups from wheat starch; and implications of the success of high-fructose corn syrup for the beet sugar industry in the USA. AJDW

## 56

### Sweetener derivatives.

Crosby, G. A.; DuBois, G. E. (Dynapol)  
*United States Patent* 4 055 678 (1977) [En]

Sweetener derivative compositions based on a dihydrochalcone with a polar group in the 4 position on each ring, one group containing a polyether and a sulphonic acid and the other group a lower alkyl. IFT

## 57

An improved conversion of hesperidin into hesperetin including purity determination by gradient-elution, high-pressure liquid chromatography.

Seitz, C. T.; Wingard, R. E., Jr.

*Journal of Agricultural and Food Chemistry* 26 (1) 278-280 (1978) [23 ref. En] [Chem. Synthesis & Analytical Lab., Dynapol, Palo Alto, California 93404, USA]

An improved procedure for the conversion of commercial hesperidin into high-purity, crystalline hesperetin, an intermediate in the synthesis of dihydrochalcone sweeteners, is reported. The crude starting material is purified by insolubles removal and recrystallization, followed by cleavage of the saccharides with sulphuric acid/methanol. The use of neat methanol in this transformation facilitates the isolation of a product uncontaminated by resinified sugars. A gradient-elution, reverse-phase, high-pressure liquid chromatography method for rapid and routine analyses of hesperidin and hesperetin is reported. Co-injection provided a means for the identification of the minor impurities isosakuranetin and its 7- $\beta$ -rutinoside detected in the hesperetin and purified hesperidin, resp. AS

## 58

[Sweeteners.] Süsstoffe.

Wagner, H. (Deutsche Gold- & Silber-

Scheideanstalt vormals Roessler)

*German Federal Republic Patent Application* 2 616 731 (1977) [De]

A sweetener is composed of 2-hydroxy-4-methylvalerianic acid or its salts of the D- and/or L- type

with the exception of sodium and potassium salts of D,L-2-hydroxy-4-methylvalerianic acid. The sweetener is suitable for adding directly to foods and beverages, both hot and cold. W&Co

## 59

Structural investigation of the sweet-tasting proteins thaumatin and monellin by immunological studies.

Wel, H. van der; Bel, W. J.

*Chemical Senses and Flavor* 3 (1) 99-104 (1978)

[21 ref. En] [Unilever Res., Vlaardingen, Netherlands]

Rabbit antibodies were produced against thaumatin I, a sweet-tasting protein of plant origin using the technique of double diffusion in agar. Cross-reactions were observed between these antibodies and thaumatin I, monellin and chemically modified thaumatins. No cross-reaction was observed between the antibodies of thaumatin I and the non-sweet-tasting iodinated monellin. This lack of cross-reaction may be due to the fact that iodination splits monellin into its A and B chains, resulting in a disturbance of the tertiary structure of the molecule. The appearance of precipitation lines from thaumatin I as well as from monellin in reaction with the antibodies of thaumatin in the immunodiffusion assay indicated that thaumatin and monellin are immunologically closely related. An identical conformational antigenic determinant in both molecules is probably responsible for this relationship. It is tentatively concluded that the identical conformational determinant coincides with the active site responsible for the sweet-taste sensation. AS

## 60

Taste of methyl- $\alpha$ -D-mannopyranoside: effects of cross adaption and *Gymnema sylvestre*.

McBurney, D. H.; Gent, J. F.

*Chemical Senses and Flavor* 3 (1) 45-50 (1978)

[10 ref. En] [Dep. of Psychology, Univ. of Pittsburgh, Pittsburgh, Pennsylvania 15260, USA]

The effects of cross adaptation and *Gymnema sylvestre* on the taste of methyl- $\alpha$ -D-mannopyranoside were studied. Results of taste panel tests showed that adaptation to quinine sulphate reduced bitterness and adaptation to sucrose reduced sweetness of methyl- $\alpha$ -D-mannopyranoside; but sucrose did not significantly reduce its bitterness. Treatment of panellists with *Gymnema* extract significantly reduced the sweet taste of sucrose and methyl- $\alpha$ -D-mannopyranoside, and caused a non significant increase in its bitterness. SP

## 61

The interrelationship between agricultural food crops for the production of sweeteners.

Gramera, R. E.

*Stärke* 30 (1) 10-23 (1978) [En, de] [Modern Process Design, Inc., 4977 Northcutt Place, Dayton, Ohio 45414, USA]



This review discusses the change in production of sweeteners due to enzymic production of high fructose syrup from any high-starch agricultural crop, e.g. corn syrup, wheat, rice, potato or tapioca. The new technology is closing the gap between sweeteners from sugar beet and cane and other food crops rich in starch. RM

## 62

### Saccharin - the risks and benefits.

Miller, A. B.; Howe, G. R.

*Nature, UK* 273 (5657) 8 (1978) [En] [Nat. Cancer Inst. of Canada, Toronto, Canada]

The conclusions of Cohen [see FSTA (1978) 10 5T178] on the risks and benefits of saccharin are questioned. A table is given estimating the incidence of bladder cancer and the effect of regular consumption of saccharin (equivalent to 1 tablet/day from age 15); for US males an expectation is derived for 67 309 cases with saccharin and 19 626 without, i.e. 47 000 bladder cancer cases/yr caused by saccharin consumption. But saccharin is ingested not only via soft drinks. The authors support the banning of saccharin as a food additive. [See also FSTA (1978) 10 4T117.] AL

## 63

### Correlation of chemical structure and taste in the cyclamate series and the steric nature of the chemoreceptor site.

Pautet, F.; Nofre, C.

*Zeitschrift für Lebensmittel-Untersuchung und -Forschung* 166 (3) 167-170 (1978) [24 ref. En, de] [Fac. de Med. Alexis-Carrel, Lab. de Biochimie, F-69008 Lyon, France]

27 N-substituted sulphamates were synthesized and studied. The requirements of compounds in the cyclamate series for sweet taste stimulation are: synclinal conformation between NH and SO in the aminosulphonate group, length <0.7 nm of the group on the N, and hydrophobic character of the latter group. A hypothetical receptor site for these compounds should have a spatial barrier at a distance of about 0.7 nm from the N interaction point with the receptor site and a hydrophobic interaction area between the N interaction point and the barrier. AS

## 64

### Gas chromatography in sweetener quality control.

Zurobski, H.; Stanislav, L. R.

*Food Product Development* 11 (9) 86-87 (1977) [6 ref. En] [Dr. Pepper Co., Dallas, Texas, USA]

The application of gas chromatography to sugar determination in the beverage industry is discussed. The technique requires expensive instruments and trained personnel, but is simple and rapid. Practical applications considered are: to determine the age of a beverage; to identify types of sweetener used; to verify composition of ingredients; and to detect contamination. VJG

## 65

### The determination of ortho- and para-toluenesulphonamides in saccharin preparations.

Roll, J. H.; Bunton, N. G.; Crosby, N. T.

*Journal of the Association of Public Analysts* 15 (1) 27-32 (1977) [5 ref. En] [Lab. of the Gov. Chem., Dep. of Ind., Cornwall House, Stamford Street, London SE1 9NQ, UK]

A method is described for the detn. of orthotoluenesulphonamide (o-TS) and para-toluenesulphonamide (p-TS) in saccharin. The method is based on GLC and uses methyl stearate as internal standard. Recoveries of o-TS and p-TS added to saccharin preparations ranged from 96-104%. Values are given for the contents of these impurities in some products currently available on the British market. The levels were considerably lower than in similar products tested about 2 yr earlier. AS

## 66

### Ingredients. A special report on the latest trends in chocolate, sweeteners and yoghurt ingredients.

Anon.

*Dairy and Ice Cream Field* 160 (12) 40-42, 44, 46 (1977) [En]

This report deals with ingredients for dairy products, covering chocolate (for chocolate ice cream, chocolate milk, ice cream novelty coatings) and chocolate extenders and replacers; stabilizers and flavours for yoghurt; and sweeteners for dairy desserts, ice cream and other frozen products. A number of ingredients with brief information on their uses is listed together with the name of the supplier. FL

## 67

### Frosted coating for sweetened foods.

Schade, H. R.; Baggerly, P. A.; Woods, D. R. (General Foods Corp.)

*United States Patent* 4 079 151 (1978) [En]

A high intensity sweetener, e.g. dipeptide aspartyl-phenylalanyl methyl ester (APM), is applied to a cereal or food surface by spraying discrete microcapsules of coating solution and partially drying the coating. GL

## 68

### The relative sweetness of fructose, glucose and xylitol in acid solutions at different temperatures.

Hyvönen, L.; Kurkela, R.; Koivistoinen, P.; Ala-Kulju, M.-L.

*Lebensmittel-Wissenschaft und -Technologie* 11 (1) 11-14 (1978) [9 ref. En] [Dep. of Food Chem. & Tech., Univ. of Helsinki, 00710 Helsinki 71, Finland]

Relative sweetness (RS) of the sugars was determined in 10% solutions at 6°, 23° or 50°C in the presence or absence of citric, malic or phosphoric acid (CA, MA, PA, resp.), each used at 2 concn. Results are expressed in terms of sweetness



relative to a 10% sucrose solution under the same conditions of temp. and acidity. RS values of fructose, glucose, and xylitol at 6°C, no acid, were 117, 70 and 103, resp.; values were similar at 23°C, but were depressed at 50°C, to 93, 64 and 80, resp. Low concn. of CA, MA and PA (0.01, 0.007 and 0.0035%, resp.) significantly increased RS values of fructose at 6°C; acid had no effect on RS of fructose at 23°C; and at 50°C, CA at 0.01 and 0.05%, MA at 0.035% and PA at 0.0035% decreased RS of fructose. Glucose and xylitol were not greatly affected by acid, except that at 50°C, RS of xylitol was  $87 \pm 1$  with 0.0175% PA vs.  $80 \pm 2$  with no acid, and at 6°C, RS of xylitol was significantly decreased by 0.0175% PA. The slight effects of acid on glucose RS were always decreases. DIH

## 69

**Yogglace, a frozen yogurt.**

Anon.

*Gordian* 78 (3) 67 (1978) [En]

A frozen yogurt has been developed by Aries International, based on milk proteins and sugars hydrolysed by a natural enzyme to provide emulsifying and stabilizing effect without additives, and galactose which does not crystallize. The product has only  $\leq 1\%$  fat, 8% sucrose, no corn syrup, no additives, and an overrun of nearly 100%. Galactose is provided by 'Yogalait', a whey hydrolysed by yeast lactase. Yogalait and Yogasucre (a galactose and glucose syrup made from whey or ultrafiltration permeate) are also used as egg and sugar replacers in bakery products, confectionery and desserts. Over 400 formulations of hydrolysed wheys and lactose have been prepared and are obtainable from A. Benakis, Hydrocal S.A., Geneva, Switzerland. RM

## 70

**Relative risks of saccharin and calorie ingestion.**

Cohen, B. L.

*Science, USA* 199 (4332) 983 (1978) [7 ref. En] [Dep. of Physics & Astronomy, Univ. of Pittsburgh, Pittsburgh, Pennsylvania 15260, USA]

The risk of a person getting cancer from ingesting saccharin is compared with the risk of ingesting additional calories which cause excess body wt. It is found that, for a person who is 10% overweight, the risk of ingesting 1 diet soft drink, which would cause a decrease in life expectancy of 9 s, is approx. equal to the risk of ingesting 1 additional kcal; i.e. if ingesting a diet drink inhibits ingestion of  $> 1$  kcal, its benefits exceed its risks. AS

## 71

**[Toxicological problems posed by the use of synthetic sweeteners (saccharin, aspartame and cyclamate) in food.] [Review]**

Fondu, M.

*Sucrerie Belge* 97 (1) 17-29 (1978) [30 ref. Fr, de, en, nl] [Inst. d'Etudes Europeennes, Univ. Libre de Bruxelles, Brussels, Belgium]

See FSTA (1977) 9 I2C516.

## 72

**Saccharin-induced sister chromatid exchanges in Chinese hamster and human cells.**

Wolff, S.; Rodin, B.

*Science, USA* 200 (4341) 543-545 (1978) [14 ref. En] [Lab. of Radiobiol., Univ. of California, San Francisco 94143, USA]

Since the induction of sister chromatid exchanges in cultured cells has been shown to be the most sensitive mammalian system to detect the effects of mutagenic carcinogens, Chinese hamster ovary cells and human lymphocytes were exposed to the sodium saccharin found to induce bladder cancer in rats. Both that saccharin and a highly purified extract of it increased the yield of sister chromatid exchanges in both types of cells. The results, which were repeatable and statistically highly significant, indicated that the weak carcinogen, saccharin, is also mutagenic in the sense that it induces cytogenetic changes. AS

## 73

**[Technology and composition of non-alcoholic beverages.] Technologie und Zusammensetzung der alkoholfreien Erfrischungsgetränke.**

Kieninger, H.

*Brauwelt* 118 (9) 262-268, 270 (1978) [De]

Non-alcoholic beverages (as defined by German regulations) must contain  $< 0.5$  wt.% alcohol; they include mineral waters (including low-mineral and synthetic) and sweetened beverages (specifically fruit squashes with varying fruit content and carbonated soft drinks). The fruit content must be  $\geq 6$  and  $\geq 3\%$  for citrus squashes and orange or lemon flavoured beverages, resp. Carbonated beverages do not need to contain added fruit juice. The basic constituents of non-alcoholic sweetened beverages are water, sugar, artificial sweeteners,  $\text{CO}_2$  and bases. The bases for lemonade and fruit squashes are made from citrus and other juice concentrates, containing approx. 50-70% extract. Aroma compounds given off during evaporation are trapped, and later used for adding to the concentrates; peel preparations and citric acid are treated in the same way. The water used has to be of potable grade with  $\leq 0.2$  mg Cl/l. and a carbonate hardness of  $\leq 5^\circ$  ( $1^\circ$  binds approx. 25 mg citric acid/l.). White or refined sugar with  $< 0.1\%$  impurities must be used; saccharin and sodium or calcium cyclamate are permitted sweeteners (in the Federal Republic of Germany). To maintain the desired  $\text{CO}_2$  content of 8-10 g/l. carbonation must be carried out at low temp. and high pressure; the operating pressure must not, however, exceed 6 atm gauge. A description is given of various production procedures in current use. Tabulated data show the composition of various non-alcoholic beverages, covering pH,  $\text{CO}_2$ , DM, total acidity, and (where relevant) calorie, fruit juice and sugar contents. TUB-IGB



## 74

**Xylitol - a specialty sweetener.**

Jaffe, G. M.

*Sugary Azucar* 73 (4) 36-38, 40, 42, 83, 86-87, 89-90 (1978) [11 ref. En, Es] [Chemical Production Dep., Hoffmann-LaRoche Inc., Nutley, New Jersey, USA]

Aspects considered in this paper on the manufacture and characteristics of xylitol include: the formula and structure of xylitol; occurrence of xylitol in fruit and vegetables; physico-chemical characteristics; relative sweetness (equal to that of sucrose); metabolism of xylitol in man; anticariogenic activity; and production of xylitol by hydrolysis of xylans (present in wood and agricultural by-products) to yield xylose, which is then filtered, purified and hydrogenated to xylitol. Future prospects for xylitol are discussed. AJDW

## 75

**Paired comparison and time-intensity measurements of the sensory properties of beverages and gelatins containing sucrose or synthetic sweeteners.**

Larson-Powers, M.; Pangborn, R. M.

*Journal of Food Science* 43 (1) 41-46 (1978) [22 ref. En] [Food Sci. & Tech., Univ. of California, Davis, California 95616, USA]

By paired comparison methods, concn. of 0.75% and 0.86% calcium cyclamate and of 0.17% and 0.19% aspartame were equivalent in sweetness to 10% sucrose in distilled water at 3° and 22° C, resp. Inherent bitterness of the compounds prevented precise assessment of relative sweetness for sodium saccharin in distilled water, and for the saccharin and cyclamate in flavoured drinks. By application of linear regression to the paired comparison data, 0.07% aspartame was calculated as equal in sweetness to 10% sucrose in lemon, strawberry and orange drinks. Because the underlying bitterness of saccharin interfered with assessment of its sweetness, a time-intensity (T-I) technique was applied. Using a chart recorder to monitor time, T-I measurements were made of the intensity and the duration of sweetness, bitterness, sourness and flavour in distilled water, and the same characteristics, plus flavour in 3 flavoured drinks, and 2 flavoured gelatins, sweetened with sucrose, cyclamate, or saccharin. T-I curves for the sensory properties of aspartame closely resembled those for sucrose in all media. Cyclamate and saccharin imparted a marked, persistent bitterness to all carriers. In gelatin, samples containing 18% sucrose were firmer initially and took longer to manipulate to a liquid in the mouth than did gelatins containing 0.105% aspartame, 0.55% cyclamate, or 0.05% saccharin. IFT

## 76

**Descriptive analysis of the sensory properties of beverages and gelatins containing sucrose or synthetic sweeteners.**

Larson-Powers, N.; Pangborn, R. M.

*Journal of Food Science* 43 (1) 47-51 (1978) [9

ref. En] [Food Sci. & Tech., Univ. of California, Davis, California 95616, USA]

2 descriptive sensory methods, anchored (deviation from a sucrose reference) and unanchored, were used to quantify differences in aroma, flavour and aftertaste in 5 media - strawberry, lemon and orange drinks, and strawberry and orange gelatins - varying in type of sweetener. With both methods, samples sweetened with sodium saccharin deviated the most from the sucrose standard, those sweetened with aspartame the least, and calcium cyclamate was intermediate. In general, drinks sweetened with sucrose or with aspartame could be characterized as "sweet-clean", and those sweetened with cyclamate or with saccharin as "sweet-chemical" and "bitter". Gelatins containing synthetic sweeteners generally were more astringent, bitter and sour, with less strawberry flavour, and were significantly less hard, springy and viscous than those sweetened with sucrose. In all media, more significant differences were observed among the sweeteners with the anchored method than with the unanchored procedure. Advantages and limitations of these 2 quantitative descriptive procedures are discussed. [See also preceding abstr.] IFT

## 77

**Fructose-saccharin and xylitol-saccharin synergism.**  
Hyvönen, L.; Kurkela, R.; Koivistoinen, P.; Ratilainen, A.

*Journal of Food Science* 43 (1) 251-254 (1978) [5 ref. En] [Dep. of Food Chem. & Tech., Univ. of Helsinki, 00710, Helsinki 71, Finland]

Synergism in fructose-saccharin (FR-SA) and xylitol-saccharin (XY-SA) mixtures whose sweetness in solution corresponded to that of a 5% sucrose solution was measured at 5, 23 and 50° C. Sensory evaluations consisted of a magnitude estimation, a paired comparison and a triangle test. Synergism between FR and SA, and XY and SA, was found to be greatest when the sweeteners were almost equal in the mixture in relation to their sweetness at the prevailing temp. Mixtures of SA and FR or XY without the aftertaste typical of SA were prepared. The sweetness of FR-SA and XY-SA mixtures in coffee was enhanced compared with that in the corresponding water solutions. It is concluded that coffee, tea and juices can be prepared to conventional taste and sweetness standards using these mixtures, but with 40-70% less energy than when sucrose is used as the sweetener. IFT

## 78

**Recent progress in the consideration of flavoring ingredients under the Food Additives Amendment. XI. GRAS substances.**

Oser, B. L.; Ford, R. A.

*Food Technology* 32 (2) 60-62, 64-66, 68-70 (1978) [12 ref. En] [Bernard L. Oser Associates, Inc., 108-118 Queens Boulevard, Forest Hills, New York 11375, USA]



This paper is the latest in a series reporting the results of deliberations of the independent panel of experts retained by the Flavor and Extract Manufacturers' Association (FEMA) for evaluation of the GRAS (generally recognized as safe) status of new flavouring substances in the USA. The new substances are listed alphabetically and their usage levels in various categories of food given. The panel also considered the GRAS status of saccharin, and decided not to change its present GRAS classification, despite the proposed banning of its use by the FDA. [See FSTA (1977) 9 4T254 for part X.] JA

## 79

**Histological examination of perinatal eye development in the rat after ingestion of sodium cyclamate and sodium saccharin during pregnancy.** Luckhaus, G.; Machemer, L.

*Food and Cosmetics Toxicology* 16 (1) 7-11 (1978) [11 ref. En] [Inst. für Toxikologie der Bayer AG, Postfach 101709, D5600 Wuppertal 1, Federal Republic of Germany]

Female rats received 5% sodium cyclamate or 0.4% sodium saccharin in their food for 20 days after mating. The ingested dose of sweetener amounted on average to 1495 mg sodium cyclamate or 98.8 mg sodium saccharin/animal/day. The findings confirmed earlier investigations that the administration of sodium cyclamate or sodium saccharin to pregnant rats is tolerated without embryotoxic effect. VJG

## 80

**The thermal energy analysis of sodium saccharin.** Krull, I. S.; Goff, U.; Wolf, M.; Heos, A. M.; Fine, D. H.; Arsenault, G. P.

*Food and Cosmetics Toxicology* 16 (2) 105-110 (1978) [38 ref. En] [Cancer Res. Div., Thermo Electron Corp., 45 First Avenue, Waltham, Massachusetts 02154, USA]

In view of the possible formation of N-nitroso impurities during the manufacture of sodium saccharin by the Maumee process (the process used by Sherwin-Williams the major US supplier) a study was undertaken to determine the presence of any N-nitroso materials in a commercial sample of sodium saccharin, applying methods and techniques similar to those used in the past to determine N-nitroso compounds. Sodium saccharin has been found to elicit a positive response, equivalent to about 0.0001 mol of an N-nitroso compound in thermal energy analysis (TEA). All efforts to ascribe this response to an N-nitroso impurity have been unsuccessful. It is concluded that the weak TEA response observed is due to the decomposition of sodium saccharin itself. VJG

## 81

**Saccharin: an epigenetic carcinogen/mutagen?**

Ashby, J.; Styles, J. A.; Anderson, D.; Paton, D. *Food and Cosmetics Toxicology* 16 (2) 95-103 (1978) [60 ref. En] [Imperial Chemical Industries

Ltd., Central Toxicol. Lab., Alderley Park, Macclesfield, Cheshire, UK]

Saccharin, sodium saccharin and 13 related compounds were evaluated using 2 in vitro carcinogenicity tests, the Salmonella mutation assay and the cell-transformation assay. The significance of these and related in vitro results is evaluated within the context of the ability of commercial saccharin to cause bladder cancer in rats and dominant lethal effects in mice. It is suggested that the available evidence indicates that the bladder tumours, the dominant lethal and the SCE effects produced by commercial saccharin, are probably due to saccharin per se and may arise via an epigenetic mechanism. VJG

## 82

**[Isomerization on ion exchange resins of lactose in aqueous solutions and whey.]**

Demaimay, M.; Baron, C.

*Lait* 58 (575/576) 234-245 (1978) [15 ref. Fr, en] [Lab. de Chimie-Biochimie Alimentaire (ENITIAA), Domaine de la Geraudiere - 44072 Nantes, Cedex, France]

A method is described for the conversion of lactose to lactulose, using an anionic exchange resin AF 003 at 40°C with a flow rate of 200-400 ml/h and a lactose concn. of 100 g/l. Under these conditions there was a 36% isomerization of lactose in aqueous solution, and about 30% isomerization of lactose in deproteinized, demineralized whey. The isomerized whey solution was decolorized and concentrated to approx. 70% DM. Removal of lactose crystals from the concentrate gave a product enriched in lactulose and with good organoleptic sweetening properties. GLC analysis of the isomerized whey solution showed that partial hydrolysis of lactose and lactulose to galactose occurred and that small amounts of an unidentified disaccharide (containing galactose, glucose or glucose + galactose) were also present. MEG

## 83

**[New trends in the production of starch hydrolysates.]**

Kosicki, Z.; Remiszewski, M.; Slominska, L. *Przemysł Spożywczy* 32 (2) 58-60 (1978) [10 ref. Pl, ru, en, fr, de]

Experiments involving starch hydrolysates are aimed at producing enzymic hydrolysis products of a high saccharification level (glucose) or with a composition and properties differing from those of acid hydrolysates (maltose, highly saccharified syrup, maltodextrins). The desire to obtain new sources of sweetening materials encourages tests on isomerization, which is an additional means of treatment of starch hydrolysate. AS

## 84

**The future of saccharin.**

Burkinshaw, M.

*Food Trade Review* 48 (4) 201-202, 204 (1978) [14 ref. En] [Nat. Coll. of Food Tech., Univ. of



Reading, Weybridge, Surrey, UK]

This paper presents recent information in chronological order, some in favour of and some against the use of artificial sweeteners, in particular saccharin. Consideration is given to UK legislation concerning artificial sweeteners and soft drinks, USA legislation relating to saccharin, carcinogenicity tests with saccharin, and possible alternatives to saccharin. VJG

## 85

**Reduced calorie foods - once we create them, do they help?**

Beck, C. I.

*Food Product Development* 12 (2) 70, 72, 74 (1978) [11 ref. En] [Kitchens of Sara Lee, Deerfield, Illinois, USA]

The problem of securing approval for high potency sweeteners is considered. Important considerations which must be satisfied for low calorie products to succeed in reducing wt. are briefly outlined. Tabulated data present: % contribution of sugar and other major food groups based on food supplies available for civilian consumption; consumer usage patterns of saccharin based table top sweeteners in homes where artificial sweeteners are used regularly; and sugar deliveries by industry, which provides some insight into what particular food classes might serve as targets for calorie reductions. Consideration is given to whether reduced calorie foods are of assistance to overweight people. VJG

## 86

**Changing sources and industrial uses of sugar.**

Kean, C. E.

*Food Product Development* 12 (3) 43, 46, 48 (1978) [9 ref. En] [California & Hawaiian Sugar Co., Crockett, California, USA]

Consideration is given to the characteristics, uses, production and consumption of corn sweeteners (including high fructose corn syrup), pure crystalline fructose and xylitol. The increasing use of sucrose and nutritive sweeteners, including corn syrup, is discussed. Tabulated data are presented for: major producers of centrifugal sugar; average annual per capita consumption of centrifugal sugar; US per capita consumption of nutritive sweeteners; world consumption of pure crystalline fructose; industrial use of sucrose and corn sweeteners; US annual per capita consumption of sucrose and corn sweeteners; and corn sweeteners as a % of total nutritive sweeteners used by different industrial categories. VJG

## 87

**Alternatives to sucrose expand sweetener choice.**

Anon.

*Food Product Development* 12 (3) 39-40 (1978) [En]

The salient characteristics and applications of the following are discussed: high fructose corn syrups; crystalline fructose; polyol sweeteners; and conventional sweeteners. VJG

## 88

**Survey of sweetener specifications. I.**

Anon.\*

*Bakery Production and Marketing* 12 (5) 95-97, 100-102, 104, 106 (1977) [En]

A guide to sweeteners for bakery applications is presented, comprising a coded usage guide for various product lines. Part I deals with beet and cane sugars including dry and liquid sucrose, invert, molasses and brown sugar. [See following abstr. for part II.] JRR

## 89

**Survey of sweetener specifications. II.**

Anon.

*Bakery Production and Marketing* 12 (6) 118-120, 122, 124-125, 128, 130 (1977) [En]

Part II of the functional description and usage guide for bakery sweeteners deals with corn sweeteners, including dextrose, corn syrups and dry corn syrup solids. [See preceding abstr. for part I, and following abstr. for part III.] JRR

## 90

**Survey of sweetener specifications. III.**

Anon.

*Bakery Production and Marketing* 12 (10) 76-78, 80, 82 (1977) [En]

A guide to the uses and characteristics of blended sweeteners for the bakery industry is presented, covering blended corn sweetener/sucrose formulations and fondants. A revised usage guide includes these and other sweeteners to which reference was made in parts I and II [see preceding abstr.]. JRR

## 91

**Glucosylsorbitol adds bulk without sweetness, calories.**

Layton, R. M.; Vlazny, J. C.

*Food Product Development* 12 (2) 53 (1978) [En] [G. D. Searle & Co., Skokie, Illinois, USA]

G. D. Searle & Co initiated an artificial sweetener programme in 1970 to produce an agent which would reproduce the physical properties of sugar but not its sweetness and caloric content. This led to the development of a new, non sweet, non-caloric bulking agent-glucosylsorbitol. The development, functionality and applications of this bulking agent/water binder are discussed. VJG

## 92

**Natural sweetener.**

Tate & Lyle Ltd.

*British Patent* 1 501 409 (1978) [En]

A powerful natural sweetener is obtained from the fruit of *Thaumatococcus daniellii* by extracting with a dilute aqueous solution of aluminium salt. IFT



## 93

## Sweetening compositions.

Eisenstadt, M. E. (Cumberland Packing Corp.)

*United States Patent* 4 085 232 (1978) [En]

Dihydrochalcone sweetening compositions contain in addition a vanilla flavour, cream of tartar, and sugar. IFT

## 94

## Glycosides having sweetness.

Takemoto, T.; Nakajima, T.; Arihara, S.; Okuhira, M. (Tsunematsu Takemoto; Nippon Shoji Co. Ltd.)

*United States Patent* 4 084 010 (1978) [En]

Artificial sweetening compositions are based upon specified glycosides. IFT

## 95

## Determination of orthotoluenesulfonamide (OTS) in soluble saccharin.

Janiak, R. A.; Damon, H. H.; Mohr, T. C.

*Journal of Agricultural and Food Chemistry* 26 (3) 710-711 (1978) [5 ref. En] [Sherwin Williams Chemicals, Toledo, Ohio 43608, USA]

A method suitable for detn. of trace amounts of OTS impurity in saccharin manufactured from toluene is described. Soluble saccharin is dissolved in water, extracted with methylene chloride, and the extract is shaken with 5% NaHCO<sub>3</sub>. The organic phase is concentrated to 1 ml and direct injection into GLC is made. No derivatization is necessary, and the GLC conditions are 2 ft × 0.25 in stainless steel columns packed with 20% SE-30 on Anakrom ABS 90/100 mesh, column temp. 225°C, injection port temp. 300°C, with flame ionization detection. Acid saccharin may be determined by dissolving in NaOH instead of water. No internal standard is used. Relative s.d. obtained with addition of OTS (to OTS-free saccharin) from 20 to 100 p.p.m. were 7.5 to 4.5%, resp. At 1 p.p.m. the s.d. is 10%. > 100 samples of sodium saccharin manufactured from toluene were examined; all contained OTS in the range 0.2-5000 p.p.m. DIH

## 96

## An intensely sweet analogue of phyllodulcin: 2-(3-hydroxy-4-methoxyphenyl)-1,3-benzodioxan.

Dick, W. E., Jr.; Hodge, J. E.

*Journal of Agricultural and Food Chemistry* 26 (3) 723-725 (1978) [7 ref. En] [N. Reg. Res. Cent., USDA, Peoria, Illinois 61604, USA]

2-(3-hydroxy-4-methoxyphenyl)-1,3-benzodioxan, an easily prepared acetal of o-hydroxybenzyl alcohol (salicyl alcohol) and 3-hydroxy-4-methoxybenzaldehyde (isovanillin), mimics the structure and taste of phyllodulcin, a rare, intensely sweet isocoumarin derivative. Preliminary tests indicate a 2 mg% solution of the new acetal to be approx. isosweet with a 6% sucrose solution, but the new acetal is slowly hydrolysed in water with loss of sweetness. AS

## 97

## Structure and taste of some dihydrochalcone glycosides.

Kamiya, S.; Konishi, F.; Esaki, S.

*Agricultural and Biological Chemistry* 42 (5) 941-950 (1978) [16 ref. En] [Food Chem. Lab., Dep. of Foods & Nutr., Shizuoka Women's Univ., Yada, 409, Shizuoka City, Japan]

The following 10 new analogues of neohesperidin dihydrochalcone (DHC) were synthesized: (i) hesperetin DHC-4'-β-L-glucopyranoside, (ii) hesperetin DHC-4'-[2-O-methyl-β-D-glucopyranoside], (iii) hesperetin DHC-4'-[3-O-methyl-β-D-glucopyranoside], (iv) hesperetin DHC-4'-[6-O-methyl-β-D-glucopyranoside], (v) hesperetin DHC-4'-β-D-glucopyranosiduronic acid, (vi) hesperetin DHC-4'-β-maltotrioxide, (vii) hesperetin DHC-4'-[β-L-glucopyranosyl-(1-2)-β-D-glucopyranoside], (viii) 3,2',4'-trihydroxy-4-methoxydihydrochalcone-4'-[α-L-rhamnopyranosyl-(1-2)-β-D-galactopyranoside], (ix) 3,4'-dihydroxy-4-methoxydihydrochalcone-4'-[α-L-rhamnopyranosyl-(1-2)-β-D-galactopyranoside], and (x) 4,2',4'-trihydroxydihydrochalcone-4'-[α-L-rhamnopyranosyl-(1-2)-β-D-galactopyranoside]. Compounds (i)-(iv) and (vi)-(ix) are 0.8, 2.0, 0.8, 4.0, 1.4, 0.02, 4.5 and 0.004 × as sweet as saccharin, resp., while (v) and (x) are tasteless. AS







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